5. (Amended) The humidifier according to claim 1, wherein an approximately central portion of said housing in the lengthwise direction is constricted toward the central direction of the axis thereof.

6. (Amended) The humidifier according to claim 1, wherein an inlet port which introduces the whole of the gas flowing outside the hollow fiber membrane into the housing, is provided on said bypass channel.

REMARKS

The Office Action dated June 7, 2002, has been received and carefully noted. The above amendments and the following remarks are submitted as a full and complete response thereto.

Claims 1-4 and 6 are presently pending. By this Response, the Specification has been amended, a new Abstract of the Disclosure has been provided, claims 1, 2, 5 and 6 have been amended and claims 7-9 have been added. All of the amendments and additions are supported by the Specification and Drawings. Thus, no new matter has been added by any of the amendments.

Applicants thank the Examiner for extending the courtesy of a telephone interview. During the interview, the Examiner discussed, with applicant's representative, proposed claim amendments. The Examiner stated that it appeared that neither Krueger et al. nor Nakanishi et al. disclosed the features recited in the amended claim 1, but that further examination and search would be required.

The drawings were objected to as failing to comply with 37 C.F.R. 1.84(p)(5).

The Examiner stated that the drawings did not include the reference numbers 100, 101, 102, 103, 104, 105, 105', 106, 107, 108 and 109 as mentioned on pages 2 and 3 Specification.

Likewise, the Examiner objected to the drawings because they include the reference number 300, 301, 302, 303, 304, 305', 306, 307, 308, and 309 as shown in Figure 14, but not appearing the Specification.

The Specification has been amended as shown so that the reference numbers in the Specification correspond to the reference numbers shown in the drawings, thus overcoming the rejection. Therefore, applicants respectfully request withdrawal of the objection to the drawings.

The Abstract of the Disclosure was objected to for the use of legal phraseology. A new Abstract of the Disclosure has been provided as shown on the attached sheet to eliminate the legal phraseology objected to by the Examiner. Thus, applicants respectfully request withdrawal of the objection to the Abstract of the Disclosure.

Claims 1-4 and 6 were rejected under 35 U.S.C. §112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter applicant regards as the invention. Specifically the Examiner states that in claim 1, line 6, "the dry air" lacks antecedent basis. In claim 2, the Examiner suggests replacing "distance" in the last line with "locations along the length of said bypass channel." In claim 6, line 7 the Examiner states that "the dry air" lacks antecedent bases. In claim 6, line 9, the Examiner states that "gas" should be made plural. Finally, on lines 9-10 of claim 6, the Examiner states that "the bypass channel" lacks antecedent basis.

The claims as amended, overcome the rejections cited by the Examiner . Thus

withdrawal of the rejection is respectfully requested.

Claims 1-4 were rejected under 35 U.S.C. §102(b) as being anticipated by Figure 1 of Krueger et al. (U.S. Patent No. 4,666,469). Applicants respectfully traverse the rejection because Krueger et al. does not disclose, teach or suggest each and every feature recited in the rejected claims, particularly claim 1.

Amended claim 1 recites a humidifier having a plurality of water-permeable hollow fiber membranes placed along the lengthwise direction of a housing accommodated within the housing in which gases each having a different moisture content flow inside and outside said hollow fiber membranes to carry out moisture exchange whereby the dry air having a low moisture content is humidified by said humidifier. Claim 1 also recites that the humidifier includes a bypass channel, in which the gas flowing outside the hollow fiber membrane, formed on an approximately central portion of the cross-lengthwise direction of said housing along the lengthwise direction of said housing. The bypass channel has a diameter larger than that of said hollow fiber membrane. Claim 1 further recites that the humidifier includes an inlet, placed at one end side of the bypass channel, which introduces the gas flowing outside the hollow fiber membrane into the housing and a plurality of outlets placed along the lengthwise direction of the bypass channel over the entire length of the bypass channel, which discharge the gas flowing outside the hollow fiber membrane formed. Finally, the humidifier of claim 1 includes a plurality of outlet ports formed on the circumferential direction of said housing several intervals and placed opposite said inlet beyond the bypass channel, which discharges the gas which had flowed outside the hollow fiber membrane.

With the above humidifier configuration of the present invention, gas from outside the membrane is introduced from one end of the gas channel placed near the center of the cross-lengthwise direction of the hollow fiber membrane. The gas is introduced from the outlets placed over the entire length of the channel into the outside of the hollow fiber membrane. The gas passing through the outside of the hollow fiber membrane is discharged from the outlet ports formed at the other end opposite said one end of the channel in the circumferential direction of the housing. Thus, gas flowing outside the membrane spontaneously flows in the direction where pressue loss is smaller, i.e. from a plurality of pores toward the outlet. Thus, gas flowing outside the hollow fiber membrane is spread over the entire area of the hollow fiber membrane to be used for humidification and is then discharged, thereby improving humidification efficiency.

Krueger et al. does not disclose, teach or suggest the plurality of outlets or the plurality of outlet ports as recited in amended claim 1. In figure 1, Kruger merely shows a hollow fiber membrane device wherein fluid enters an inlet 1 provided on one end of the device and flows from pores of a dispersing means 2 to the outside of the membrane, after which it reaches a single outlet 7 provided near the center portion of the pressure case 8, and is then discharged.

Consequently, Krueger et al. does not teach or suggest a plurality of outlets placed along the lengthwise direction of the bypass channel over the entire length of the bypass channel, nor does Krueger teach or suggest a plurality of outlet ports formed in a circumferential direction of the housing at several intervals and placed opposite said inlet beyond the bypass channel as recited in amended claim 1. Therefore, claim 1 is

patentable over Krueger et al. Thus, applicants respectfully request withdrawal of the rejection of claim 1 under 35 U.S.C. §102(b) over Krueger et al.

Claims 2-4 depend from claim 1 and are patentable for at least the reasons discussed above with respect to claim 1. Thus, applicants respectfully request withdrawal of the rejection of claims 2-4 under 35 U.S.C. §102(b) over Krueger et al.

Claims 1-4 were rejected under 35 U.S.C. §102(b) as being anticipated by Figures 1, 4a and 5 of Nakanishi et al. (U.S. Patent No. 6,210,464 B1). Applicant's respectfully traverse this rejection because Nakanishi does not disclose teach or suggest all the features recited in amended claim 1.

In the mixed gas separating membrane module disclosed by Nakanishi et al., fluid, flowing outside of the membrane enters from a gas feed section 2 provided in the lengthwise direction of a gas feed inlet 10, flows from cylindrical film member 11 provided at only one end of the gas feed inlet 10 to the outside of the membrane. The fluid reaches only one gas delivery section 3 near the opposite end of the cylindrical container 1 and is then discharged.

Therefore, Nakanishi et al., like Krueger et al., does not teach or suggest a plurality of outlets placed along the lengthwise direction of the bypass channel over the entire length of the bypass channel. Nakanishi et al. also does not teach or suggest a plurality of outlet ports formed in a circumferential direction of the housing at several intervals and placed opposite said inlet beyond the bypass channel as recited in amended claim 1. Therefore, claim 1 is patentable over Nakanishi et al. Thus, applicants respectfully request withdrawal of the rejection of claim 1 under 35 U.S.C. §102(b) over Nakanishi et al.

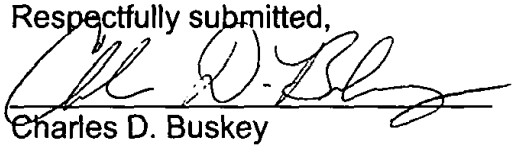
Claims 2-4 depend from claim 1 and are patentable for at least the reasons discussed above with respect to claim 1. Thus, applicants respectfully request withdrawal of the rejection of claims 2-4 under 35 U.S.C. §102(b) over Nakanishi et al.

Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over either of Krueger et al. or Nakanishi et al., taken in view of applicant's admitted prior art as depicted by Figure 14 of the instant application. The rejection is respectfully traversed because neither Krueger et al. or Nakanishi et al disclose, teach or suggest all the features recited in claim 6.

Claim 6 recites a method conducted by the identical elements as recited in claim 1. As discussed above neither Krueger et al. nor Nakanishi et al. disclose teach or suggest all the features recited in claim 1. Therefore, even when combined, Krueger et al. and Nakanishi et al. fail to meet all the features recited in amended claim 1. Moreover, Applicant's admitted prior art (APA) fails to remedy any of the deficiencies of Krueger et al. and Nakanishi et al. as it also fails to teach or suggest a plurality of outlets placed along the lengthwise direction of the bypass channel over the entire length of the bypass channel. The APA also does not teach or suggest a plurality of outlet ports formed in a circumferential direction of the housing at several intervals and placed opposite said inlet beyond the bypass channel as recited in amended claim 1 as shown in figure 14. Therefore, claim 6 is patentable for the same reasons as discussed above with respect to claim 1. Thus, applicant's respectfully request withdrawal of the rejection of claim 6 under 35 U.S.C. §103(a) as being unpatentable over either of Krueger et al. or Nakanishi et al., taken in view of applicant's admitted prior art

In the event this paper is not considered to be timely filed, the Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to Counsel's Deposit Account No. 01-2300 making reference to Attorney Docket No. 106145-00016.

Respectfully submitted,



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Marked of Copy of the Specification
Marked Up Copy of the Claim
New Abstract

MARKED UP COPY OF THE SPECIFICATION

On Page 1, please amend the paragraph starting at line 25 as follows:

A conventional humidifier utilizing hollow fiber membranes is disclosed in Japanese Laid-open Patent Publication No. HEI-7-71795. As shown in Fig. 14, a humidifier [100] 300 comprises a housing [101] 300, on which is provided a first inlet [102] 302 for introducing dry air and a first outlet [103] 303 for discharging the dry air (humidified dry air). A bundle of hollow fiber membranes [104] 304 consisting of a number of for example 5000 hollow fiber membranes is accommodated within the housing [101] 301.

On page 2, please amend the paragraph starting at line 8 as follows:

At both ends of the housing [101] 301, fastening members [105] 305, [105'] 305' are provided for fixing the ends of the bundle [104] 304 while leaving them open. Outside of the fastening member [105] 305 is provided a second inlet [106] 306 for introducing moist air or moist gas, and a second outlet [107] 307 is provided outside of the fastening member [105'] 305' for discharging the moist air, moisture of which is separated and removed at the bundle of hollow fiber membranes [104] 304. The fastening members [105] 305, [105'] 305' are covered with a first head cover [108] 308 and a second head cover [109] 309, respectively. And the second inlet [106] 306 is formed on the first head cover [108] 308, while the second outlet [107] 307 is formed on the second head cover [109] 309.

On page 2, please amend the paragraph starting at line 20 as follows:

In the aforementioned humidifier [100] 300 utilizing hollow fiber membranes, the moist air introduced from the second inlet [106] 306 passes through the hollow fiber membranes forming the bundle of hollow fiber membranes [104] 304, and the moisture within the moist air is separated by capillary action of the hollow fiber membranes. The separated moisture moves outward of the hollow fiber membrane through a capillary tube of the membrane. The moisture-removed air is discharged from the second outlet [107] 107.

On page 3, please amend the paragraph starting at line 3 as follows:

Meanwhile, dry air is supplied from the first inlet [102] 302. The dry air from the first inlet [102] 302 flows outside of the hollow fiber membranes forming the bundle of hollow fiber membranes. Because the moisture separated from the moist air has moved outside of the hollow fiber membranes, the moisture humidifies the dry air. The humidified dry air is then discharged from the first outlet [103] 303.

On page 2 please amend the paragraph starting at line 10 as follows:

However, in the conventional humidifier [100] 300 shown in Fig. 14, the first air inlet [102] 302 which introduces the dry air is formed on the housing [101] 301 at the side near the center of the lengthwise direction thereof. For this reason, as shown in the black arrow of Fig. 14, the dry air flowing outside of the hollow fiber membranes in the bundle [104] 304 of the hollow fiber membrane stored within the housing [101] 301 flows the central portion in the lengthwise direction within the housing [101] 301.

Consequently, the areas S residing near the ends of the bundle [104] 304 of the hollow fiber membranes do not contribute to the exchange of water in a sufficient manner and, thus there is a problem that the ratio of moisture recovery at such portions unduly low in relative to the permeable water within the hollow fiber membranes.

MARKED UP COPY OF THE CLAIMS

1. (Amended) A humidifier having a plurality of water-permeable hollow fiber membranes placed along the lengthwise direction of a housing accommodated within the housing in which gases each having a different moisture content flow inside and outside said hollow fiber membranes to carry out moisture exchange whereby [the] dry air having a low moisture content is humidified, said humidifier comprising:

a bypass channel, in which the gas flowing outside the hollow fiber membrane, formed on an approximately central portion of the cross-lengthwise direction of said housing along the lengthwise direction of said housing,

said bypass channel having a diameter larger than that of said hollow fiber membrane, and

an inlet, placed at one end side of said bypass channel, which introduces the gas flowing outside the hollow fiber membrane into the housing; [and]

[an outlet] a plurality of outlets placed along the lengthwise direction of said bypass channel over the entire length of the bypass channel which [discharges] discharge the gas flowing outside the hollow fiber membrane formed on said bypass channel; and

a plurality of outlet ports formed in a circumferential direction on said housing at several intervals and placed opposite said inlet beyond the bypass channel, which discharges the gas which has flowed outside the hollow fiber membrane.

2. (Amended) The humidifier according to Claim 1, wherein a plurality of the outlets which discharge the gas flowing outside the hollow fiber membrane are

formed on said bypass channel at several [distance] locations along the length of said bypass channel.

5. [A fuel cell system having the humidifier according to any one of claims 1 to 4] The humidifier according to claim 1, wherein an approximately central portion of said housing in the lengthwise direction is constricted toward the central direction of the axis thereof.

6. (Amended) [A humidification process utilizing a hollow fiber membrane module comprising a plurality of water-permeable hollow fiber membranes placed along the lengthwise direction of a housing accommodated within the housing, in which gases each having a different moisture content flow inside and outside said hollow fiber membranes to carry out moisture exchange whereby the dry air having a low moisture content is humidified, comprising:

a step for subjecting one of said gas to flow in the bypass channel;

a step for subjecting said gas from the bypass channel to flow outside the hollow fiber membrane; and

a step for carrying out a moisture exchange between said gas flowing outside the hollow fiber membrane and the gas flowing inside the hollow fiber membrane] The humidifier according to claim 1, wherein an inlet port which introduces the whole of the gas flowing outside the hollow fiber membrane into the housing, is provided on said bypass channel.

ABSTRACT OF THE DISCLOSURE

A humidifier having a plurality of water-permeable hollow fiber membranes placed along the lengthwise direction of a housing accommodated within the housing in which gases each having a different moisture content flow inside and outside the hollow fiber membranes to carry out moisture exchange whereby the dry air having a low moisture content is humidified is disclosed. The humidifier includes a bypass channel having a larger diameter than that of the hollow fiber membrane, in which the gas flowing outside the hollow fiber membrane, formed on an approximately central portion of the cross-lengthwise direction of the housing along the lengthwise direction of the housing, and an inlet which introduces the gas flowing outside the hollow fiber membrane into the housing and an outlet which discharges the gas flowing outside the hollow fiber membrane formed on the bypass channel.